

**UNIFORM INTERLOCKING FOAM PACKING MATERIAL/
BUILDING MATERIAL APPARATUS AND METHOD**

Attorney Docket No. 13471:11
Customer ID No. 22444

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Dated: January 2, 2002

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Certification Under 37 C.F.R. 1.10

"EXPRESS MAIL" mailing label number: EL 288602238 US

Date of Mailing: January 2, 2002

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TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to
5 fabricated foam products and more specifically it relates
to an interlocking packing material/building material
apparatus and method for allowing the manufacture and use
of uniform building components that have a pre-use life
as packing materials.

10 BACKGROUND OF THE INVENTION

It can be appreciated that fabricated expanded
polystyrene and expanded polypropylene foam products have
been in use for years. Typical fabricated foam products
for packaging are comprised of foam peanuts, formed
15 cardboard from recycled pulp, injected form fitted foam,
and the like. Typical fabricated foam products for
building materials are stackable foam concrete molds,
structural insulated panels (SIP's), foam insulation
panels, and the like.

20 Conventional fabricated foam products have an impact
on landfills. Discarded foam materials will stay in
today's sealed landfills indefinitely with no decrease in
structural integrity. Of greater impact than their
longevity is the size and bulk of foam products when
25 dumped into the standard landfill. Foam cannot be
further compacted and thereby takes up large amount of
space relative to its weight.

Conventional fabricated foam products have a single,
targeted end use, for example as a protective packaging
30 material, while any second life of the material is an
afterthought. As a result, the product has limited use
and the costs associated with any recycling efforts are

high. There is little financial incentive to recycle conventional fabricated foam products. Additionally, there is little or no social or psychological incentive to recycle. Any foam product is perceived as a single
5 use product, resulting in the production of foam products in separate non-interacting fields of use.

While ease of handling on the building job site and the natural insulating properties of foam make it a desirable building material, its bulk causes the cost of
10 shipping it to be high.

The bulkiness of foam packaging materials also makes their handling, storage, and processing a time consuming, costly procedure. Conventional foam packing materials do not nest together easily. As a result, it is
15 inconvenient to ship them from the foam fabricator to the product packager, to store them until needed for packaging products, and to count them for inventory purposes.

While these foam products may be suitable for the particular purpose for which they are designed, they are not suitable for allowing the manufacture and use of uniform building components that have a pre-use life as packaging materials.
20

In these respects, the uniform interlocking packing material/building material system according to the present invention substantially departs from the conventional concepts and designs of the prior art, and in so doing provides an apparatus primarily developed for the purpose of allowing the manufacture and use of
25 uniform building components that have a pre-use life as packaging materials.
30

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages inherent in the known types of fabricated foam products now present in the prior art, the present invention provides a foam structure for use as packaging material which can be interlocked with other like designed structures to compose a block of building material.

A building block composed of previously used foam packaging material can reduce the production of packaging waste by creating a social and financial incentive to recycle such packaging material.

Utilizing foam packaging material to compose structural units of building material confers on them the benefits of the longevity of the foam materials.

Forming building material from foam packaging material also reduces the ecological impact of discarded foam packaging materials while creating building materials that will enable affordable housing for many.

Foam packaging material that can be interlocked into blocks of building material can also be conveniently stacked, inventoried, shipped and stored prior to its use as packaging material.

More specifically, aspects of the invention can be found in a foam structure for protecting a product in a package. The foam structure fits within the package and at least one side of it is formed to protect the product. The foam structure is also capable of interlocking with another foam structure, concrete or wood to form a structural unit of building material.

Other aspects of the invention can be found in a method of protecting a product in a package using

building material components. One step in the method is placing at least one foam structure that is formed to fit within the package in contact with the product. The foam structure has at least one side formed to protect the product and it has a side capable of interlocking with an element to form a structural unit. The foam structure protects the product while the product is in contact with the foam structure within the package. The structural unit can be used as building material.

10 A further step in the method is shipping, storing or counting the foam structures while they are interlocked with other foam structures.

Aspects of the invention also can be found in a packing structure that has two nested parts, a first part formed to fit within a package and a second part formed to fit a product. Either part can interlock with another element to form a structural unit that can be used as building material. The two parts can be made of differing materials.

20 Other aspects of the invention can be found in a method of protecting a product in a package using building material components. One step in the method is joining two parts to form a shipping protection element that fits within the package and protects the product.

25 At least one side of one of the parts is capable of interlocking with an element to form a structural unit that can be used as building material.

Further aspects of the invention can be found in a method of combining shipping protection structures to form building material. The shipping protection structure has two parts and it protects a product in a package. Steps in the method include disassociating the

two parts of the shipping protection structure and joining at least one part with an element to form a structural unit that can be used as building material.

Other aspects of the invention can be found in a structural unit that can be used as building material, and that is made from packing material for a product in a package. The structural unit is made of at least two interlocked foam structures. At least one of the foam structures has at least one side formed to engage the product in the package, and it has a side capable of interlocking with another foam structure to form the structural unit. The foam structures are capable of inhibiting damage to the product in the package.

The foam structures can be secured with adhesive or with fastening devices to form the structural unit. The structural unit can be part of a construction product or a flotation product. The structural unit can be part of a wall form and can be attached to the wall with a connector. The structural unit can be attached to the other side of the wall form with a connector.

Aspects of the invention also can be found in a structural unit that can be used as building material, and that is made from packing material for a product in a package. The structural unit has at least one foam structure that is formed to fit in the package. The foam structure has at least one side that is formed to engage the product, and a side capable of interlocking with an element to form the structural unit. The foam structure is capable of inhibiting damage to the product in the package. The structural unit has a conduit.

The conduit can be formed within the foam structure or can be formed by the interlocking of the foam

structure to the element. The conduit can be used for the passage of electrical conductors, air or a fluid. As before, the structural unit can be part of a wall form and can be attached to the wall with a connector. The
5 structural unit can be attached to the other side of the wall form with a connector.

Further aspects of the invention can be found in a method of creating building material from packing material for a product in a package. One step in the
10 method is combining a foam structure and an element to create a structural unit that can be used as building material. The foam structure is formed to fit within the package and has a first side that is formed to protect the product, and a side capable of interlocking with the
15 element to form the structural unit.

As before, the foam structure and element can be secured with adhesive or with fastening devices to form the structural unit. The structural unit can be part of a construction product or a flotation product. The
20 structural unit can be part of a wall form and can be attached to the wall with a connector. The structural unit can be attached to the other side of the wall form with a connector.

There has thus been outlined, rather broadly, the
25 more important features of the invention in order that the detailed description thereof may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional features of the invention that will be described
30 hereinafter.

Other aspects, advantages and novel features of the present invention will become apparent from the detailed

description of the invention when considered in
conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference should be made to the following Detailed Description taken in

5 connection with the accompanying drawings in which:

FIGURE 1 is a perspective view of a piece of foam packing material that can interlock to form building material according to the invention;

FIGURE 2 is the reverse view of the foam structure
10 of Figure 1;

FIGURE 3 shows the foam structures of the invention being used to package a product;

FIGURE 4 is a perspective view of alternative foam structure according to the invention;

FIGURE 5 is the reverse view of the foam structure
15 of Figure 4;

FIGURE 6 shows the foam structure of Figure 4 being used to package a product;

FIGURE 7 is a perspective view of another foam
20 structure according to the invention;

FIGURE 8 is the reverse view of the foam structure of Figure 7;

FIGURE 9 shows the foam structure of Figure 7 being used to package a product;

FIGURE 10 is a foam structure and an insert formed
25 to nest together and to hold a product for packaging;

FIGURE 11 depicts an alternative foam structure according to the invention;

FIGURE 12 depicts building material composed
30 according to the invention;

FIGURE 13 illustrates building material composed according to the present invention from alternative foam structures;

FIGURE 14 depicts building material alternatively
5 composed according to the invention;

FIGURE 15 shows building material of Figure 14 composed from an alternative foam structure;

FIGURE 16 shows foam structures stacked according to the invention for shipping, storage or inventory purposes;

FIGURE 17 illustrates building material composed according to the invention for use in a wall form with a connector for attaching it to the wall;

FIGURE 18 depicts building material composed
15 according to the invention and containing conduits; and

FIGURE 19 is a view of two foam structures according to the invention secured by a fastening device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For a more complete understanding of the present invention and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which like reference numbers indicate like features and wherein:

FIGURE 1 depicts a foam structure 1 according to the invention for protecting a product while packed. Sides 5 and 6 of the structure are designed to interlock with other elements bearing a similar set of features. Side 10 of the structure is smooth. Cavity 7 is formed in sides 5 and 6 to accept an outer contour of a product, which the foam structure will protect when used as packing material.

FIGURE 2 shows the other three sides of the foam structure of FIGURE 1. Sides 8 and 11 are smooth and side 9 is designed to interlock with side 6 or side 9 of a like designed structure.

FIGURE 3 illustrates structure 1 and like designed structures 2, 3 and 4 placed around a product. In this exemplary embodiment of the invention, the product is not robust and the product and foam structures would be placed inside a box for storage or shipping. If the product were robust, heavy duty plastic wrap, shrink wrap plastic, strapping tape or the like could be used to secure the foam structures around the product and package it for shipping or storage.

Another exemplary embodiment of the invention is presented in FIGURE 4. Foam structure 81 has a common interlocking pattern on sides 83, 84 and 85. Structure 81 has cavity 86 formed in side 84 to accept an outer contour of a product.

The other sides of foam structure 81 are shown in FIGURE 5. It can be seen that sides 87, 88 and 89 have the same interlocking pattern as the three sides of structure 81 visible in FIGURE 4. Thus any of the six
5 sides of structure 81 can interlock with any side of another like designed structure, or with sides 6 or 9 of structure 1 in FIGURE 1.

Foam structure 81 and like designed structure 82 can be seen in FIGURE 6 engaging a product, ready to be
10 placed in a box or other shipping container. Again, if the product is robust, other methods could be used to secure the product within the foam structures and package it for further handling.

FIGURE 7 presents yet another exemplary embodiment
15 of the invention. Sides 98, 99 and 100 of foam structure 91 are visible, and it can be seen that sides 98 and 99 are patterned to interlock with each other or with any of the sides of structure 81 of FIGURE 4. Side 100 of structure 91 in FIGURE 7 is smooth. Cavity 101 is formed
20 in three sides of structure 91, side 99, visible in FIGURE 7, and sides 102 and 104, visible in FIGURE 8.

Still referring to FIGURE 8, which shows the reverse sides of structure 91, side 104 is smooth, while sides 102 and 103 have the same interlocking pattern as sides
25 98 and 99.

In FIGURE 9, foam structure 91 and like designed structures 92 through 97 are seen engaging seven corners of a product, to serve as packing material when they are placed inside a shipping or storage container. An eighth
30 like designed foam structure engaging the remaining corner of the product is not visible in FIGURE 9.

Another exemplary embodiment of the foam structures of the present invention is depicted in FIGURE 10. Foam structure 31 is formed with a standardized cavity 37 into which can be inserted another structure 35 with a cavity 36 created to fit the outer contour of a product. In this way, a standardized foam structure 31 could be produced and used to package a variety of different products by utilizing customized structures 35 for each different product.

Alternatively, structure 31 could be made from expanded polypropylene, a more durable material than expanded polystyrene, while structure 35 is made from the less expensive material, expanded polystyrene. When packing material of this design is received for recycling, the structure 35 could be removed and used, according to the invention, to form building material. Structure 31 could be reused with a different insert as packaging material, until such time as it too is used, according to the invention, to form building material.

If common interlocking patterns are used on the sides of structures 31 and 35, they can be left nested before they are used to form building material or they can be disassociated and used separately. Two parts 31, two parts 35 or one part 31 and one part 35 could be interlocked.

Smaller products may not need to be packaged in four foam structures, as shown in FIGURE 1. Foam structure 41 illustrated in FIGURE 11, having cavities 46, 47 and 48 formed in product packaging side 45, could be used on its own to package, in this exemplary embodiment, three cylindrical products for shipping. Cavities 46, 47 and 48 are fitted with raised contact points, which compress

to absorb force when the packaged product is subjected to the sharp deceleration of being dropped or bumped.

Shrink-wrap plastic, strapping tape, or a box or other container could be used to package the products in the foam structure. Alternatively, two foam structures 41 could be placed with their product packaging sides 45 in contact, thereby completely surrounding the packaged product in mating cavities 46, 47 and 48. Again, shrink-wrap plastic, strapping tape, a box or the like could be used to package the products within the foam structures.

The foregoing discussion has described several exemplary embodiments of the foam structures of the invention and their uses as packing material. In view of these descriptions and drawings, other modifications and variations will now become apparent to those skilled in the use of foam structures as packing material. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention.

Illustrating now the formation of building material according to the invention, FIGURE 12 shows foam structures 1, 2, 3 and 4 interlocked to form structural unit 50. It can be seen that sides 5 and 6 of foam structure 1 interlock with like designed sides of foam structures 2 and 4, respectively. Side 9 of foam structure 1 and the corresponding sides of foam structures 2, 3 and 4 form an outer side of unit 50 that can interlock with a side of a unit composed of like designed foam structures. When a number of units 50 are stacked to form a wall, the wall will have a smooth face made up of side 8 of foam structure 1 and the corresponding smooth sides of foam structures 2, 3 and 4.

The interlocking features of the foam structures composing structural unit 50, and the features that interlock unit 50 to other like composed units when used to create a wall, panel or other structure, prevent drafting or air seepage through and between the units. The foam structures of FIGURE 6, having interlocking patterns on all six sides, provide this benefit to an even greater degree. This benefit is also obtained with the other embodiments of the invention illustrated herein.

The particular interlocking feature pattern shown on side 6 and 9 of foam structure 1 in FIGURE 12 also has the benefit of allowing unit 50 and other like designed units to interlock when laid in the staggered pattern commonly used for brick laying. It has the further benefit of allowing units of different lengths to be combined to compose a wall, panel or other structure. It should be understood, however, that other interlocking patterns could be used that do not provide these two particular benefits, while still falling within the spirit and scope of the present invention.

In another exemplary embodiment of the invention, FIGURE 13 shows a structural unit 51 made from foam structures 11, 12, 13 and 14. These foam structures have features molded into their sides that form post 16 surrounded by annular cavity 15 when the foam structures are combined to form unit 51. A rubber band or other fastening device can be placed around post 16 to hold the foam structures together while unit 51 is being handled.

Foam structures 1, 2, 3 and 4 are shown stacked in FIGURE 14 to form structural unit 52 in another exemplary embodiment of the invention. In this embodiment, side 9

of foam structure 1 forms the upper side of unit 52, while side 6 of foam structure 1 interlocks with a side of foam structure 2. Structures 3 and 4 are similarly stacked beneath structure 2 to form structural unit 52

5 Side 8 of foam structure 1 and the corresponding smooth sides of structures 2, 3 and 4 are oriented in the same direction to give unit 52 a smooth side. However, it can be seen that the foam structures could also be stacked with smooth structure sides appearing on both sides of

10 unit 52.

In yet another exemplary embodiment of the invention, FIGURE 15 shows a structural unit 53 composed of foam structures 21, 22, 23 and 24. These foam structures are comparable to previously described foam

15 structures 1, 2, 3 and 4, except for the lack of protrusions on side 5 of foam structure 1 and on the corresponding side of foam structures 2, 3 and 4. Side 5 and the corresponding sides of the other foam structures 21, 22, 23 and 24 are smooth, except for the cavity

20 formed to accept the product they protect when used as packing material.

Cavities in the side walls of structural unit 53 of FIGURE 15 or in the interior of unit 50 of FIGURE 12, or in the other embodiments shown herein, can be filled with

25 additional material for the purpose of improving the insulating properties of the unit, and, in the case of external cavities, for the purpose of presenting a smooth side wall on the unit. This additional material could be hardened liquid foam, loose fill insulation, blown

30 insulation, a fitted piece of molded foam, or other like material.

FIGURE 16 shows a portion of the structural unit 53 of FIGURE 15, depicting fastening device 25 being used to secure foam structures 21 and 22 to each other. Another such fastening device (not shown) can be used at the other end of the foam structures to further secure them to each other. Likewise, additional fastening devices can be used to secure the other foam structures of structural unit 53 to each other. By so doing, unit 53 can be prevented from separating into its component foam structures.

FIGURE 17 illustrates yet another advantage of the present invention. The foam structures can be assembled into a large bundle 54 for ease of shipping and storage prior to their use as packing material. Additionally, the total number of foam structures in such a bundle 54 can be easily calculated by counting the number of structures across the bottom and the number down the side and multiplying those two numbers.

Walls constructed from pourable building material (e.g., pourable concrete) are conventionally formed by erecting two wall form panels with a cavity between them and pouring the building material into the cavity. Often, one or both wall form panels are formed of foam material and the panel is left in place after the wall material has cured, to form thermal and acoustic insulation for the finished wall.

The structural units of the present invention can be used to assemble wall form panels for this purpose. When this is done, any interlocking pattern on the sides of the component foam structures exposed to the inside of the wall form will be captured by the pourable building

material when it cures, thereby interlocking the structural units to the wall.

Structural units can also be attached to the finished wall through the technique shown in FIGURE 18. 5 Foam structures 61 and 62 are shown having orifices 65 and 66, respectively, for receiving connector 67. Alternatively, after foam structures are assembled to compose a structural unit, orifices 65 and 66 could be formed in the unit at the desired location for connector 10 67. Connector 67 may reach partially across the cavity between the two wall form panels. When pourable building material is subsequently poured into the wall form it will flow past the connector 67 and into the cavity 68 in the connector and, once cured, capture the connector in 15 the wall thus formed. Connector 67 will then serve to attach the structural unit composed of foam structures 61 and 62 to the finished wall.

Alternatively, connector 67 may reach fully across the cavity and attach the two wall form panels together 20 prior to the pouring of the pourable building material. If the other wall form panels are composed of structural units of the present invention, connector 67 may be received in orifices, as described for foam structures 61 and 62. If plywood or other material is used for the 25 other wall form panel, the connector 67 may be provided with holes 69 and 70 for receiving a fastener to attach the connector to the other wall form panel.

Structural units of building material composed, according to the invention, of foam structures used for 30 product packaging can be used for the creation of other construction products than the wall forms discussed above. Structural insulated panels can be formed by

assembling such foam structures into a panel and cladding the panel with particleboard or other such material. The cladding material may be provided with an interlocking pattern matching that found on the foam structures, thereby interlocking the cladding material to the foam structures. Structural units formed from foam structures can be used to build retaining walls and façades. In a further example, structural units composed according to the invention can be built into a panel, covered with a wire mesh, and concrete or stucco blown onto the mesh to form a wall or fence.

Structural units composed according to the invention can also be used to form flotation products such as floats for boat docks or as filler for pontoons.

FIGURE 19 depicts foam structures 71 and 72 in another exemplary embodiment of the invention. Conduits 75 and 76 are formed extending through foam structures 71 and 72, respectively, to allow the passage of items such as pipes, electrical cables, ducts and the like. When structural units composed of like designed foam structures are stacked end to end as part of a wall or panel, a continuous conduit will be formed, allowing the passage of such items along the length of the wall or panel.

Foam structures 71 and 72 can also be molded with cavities 77 and 78 in the side. In this way, when the foam structures are interlocked to create a structural unit, the mating cavities form a conduit extending through the unit, as illustrated in FIGURE 19. Cavity 77 or 78 could be formed in any side of the foam structure, and it will form a conduit when interlocked with any other element, even one without a matching cavity.

Air can be passed through the conduit without using a duct by placing a liner along the inside of the conduit prior to composing the foam structures into a structural unit. Alternatively, the conduit can be left untreated and the air allowed to pass along the raw foam conduit.

Similarly, water or other fluid can be passed through the conduit without using a pipe by placing a liner along the inside of the conduit, or by treating the surface of the conduit with a waterproof sealant. When a conduit is formed from mating semi-cylindrical cavities 77 and 78, the foam structures would be joined with adhesive or other sealant to prevent fluids leaking between them. For a similar reason, foam structures abutted end to end would be sealed with adhesive or other sealant to form an extended conduit for carrying fluid.

Yet another benefit is obtained if conduits 75 and 76 or semi-cylinders 77 or 78 lead into the product cavity formed in the foam structure, for example, cavity 86 in side 84 of structure 81 of FIGURE 4. If side 84 is positioned on an outer side of a structural unit such as a structural insulated panel (SIP), a hole may be cut in the cladding material for mounting an electrical outlet box. Cavity 86 would then provide empty space in the SIP to receive the outlet box and the conduit would provide space for the passage of the electrical cables connected to the outlet box. Louvers for directing air could be similarly mounted over cavity 86 to provide an outlet for air passing through a conduit in the structural unit.

Many structural units made of two and four foam structures have been described specifically above. Of course, many different units and interlocking designs as

well as any number of interlocked foam structures may be used within the scope of this disclosure.

As such, an apparatus and method for a foam structure for protecting a product while packed which may be used to compose building material is described. In view of the above detailed description of the present invention and associated drawings, other modifications and variations will now become apparent to those skilled in the art. It should also be apparent that such other modifications and variations may be effected without departing from the spirit and scope of the present invention as set forth in the claims which follow.

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